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ABSTRACT

Intended for employers concerned about problem solving and communication within their organization, this document outlines a strategy for developing an instrument that would provide objective data rather than impressionistic data. A questionnaire was designed to explore the relationship between the central constructs of problem solving and communication and the organizational climate. Data from the questionnaire were used to identify the obstructive factors and seek solutions to them. The reliability and validity of the questionnaire are discussed in detail. An appendix to the document listing the six possible obstructive factors found in the questionnaire follows a list of references. (JC)

ED 094104

A NEEDS ANALYSIS INSTRUMENT FOR FOCUSING TRAINING ACTIVITIES IN COMPLEX ORGANIZATIONS

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by

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for

ADULT EDUCATION RESEARCH CONFERENCE

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OVERVIEW

The purpose of this study was to develop an instrument that would, with validity and reliability, provide objective rather than impressionistic data about problem solving and communication patterns within complex organizations. The strategy for satisfying that purpose included:

1. Searching the literature to build a nomological network that related to the two constructs, problem solving and communication.

2. Developing questions from the nomological network that when responded to by top and middle management and when analyzed would provide information to allow management to move effectively, through training, to improve the capability of managers in large organizations to solve problems and to communicate.

3. Applying the instrument in a large organization as a test case so that data could be gathered to point out the validity and reliability of the instrument.

4. Using accepted scientific approaches to show the validity and reliability of the instrument.

What was done

Development of the instrument. The literature was searched for concepts that would relate to the central constructs, problem solving and communication. Nine obstacles to problem solving and communication were identified from the literature (Appendix A) and designated first-level nomologicals within the nomological network. The nomological network was subsequently used to predict the relationships between the central constructs and the items on the questionnaire. Further search of the literature identified varying aspects of each first-level nomological. These aspects were called second-level nomologicals. From the second-level nomologicals, specific questions were written by the author for inclusion on the questionnaire. The inferential steps in arriving at the questions from the constructs were, therefore, publicly and explicitly stated, satisfying that requisite for claiming construct validity. A further consequence of this process was that the questions for the questionnaire were articulated and ready for assembly in the form that was used in the test case.

The test case. The questionnaire was tested using top and middle management at Dorothea Dix Hospital, a state operated mental health facility located in Raleigh, North Carolina. Of the 128 questionnaires distributed 118 were properly completed and returned, producing a response level of 92.19 percent.

The questionnaire was introduced to the prospective participants through highly personalized small group presentations. The presentation topics included purpose, anticipated outcomes, expected follow-through, and the level of interest on the part of the hospital's top management in the outcomes. This approach was adopted to increase reliability, since introducing the questionnaire that way tended to reduce measurement errors by making all items and instructions "perfectly clear" to the respondents.

The respondents received the questionnaire in personally addressed envelopes, containing a cover letter from the hospital superintendent, instructions for participants, the questionnaire, and return envelopes. Two weeks were allowed for completion of the questionnaires and no follow-up took place for delinquent questionnaires except in the case of the hospital's top management.

The data were analyzed to provide information to the hospital's top management. The format of the analyzed information given to the executives was a list of first-level nomologicals ranked in sequence of priority for action. The priority statistic was the principal input to the development of action programs to strengthen the ability of hospital management to do problem solving and communication.

Validity. The nomological network made public the inferential relationships of the questions on the questionnaire to the constructs, problem solving and communication. It was also essential that contact with observables be demonstrated in order to justifiably claim construct validity. The way used to provide the linkage between the constructs and observables was to factor analyze the responses of the participants in the test case.

As was expected the factor analysis showed the constructs to be multi-dimensional. The theoretical network of nomologicals also made reasonably realistic contact with observables, considering the needed trade-offs between theoretical purity and questionnaire utility in measuring the real social situation of the test case. Based on the study having satisfied the prerequisites for construct validation, construct validity was claimed for the questionnaire.

Reliability. An analysis of variance was produced which provided input to a formula to calculate Cronbach's Alpha, which is a descendant of Kuder-Richardson's "20" and is a measure of the internal consistency of the questionnaire. Alpha was high enough to be reassuring and the value of the standard error was low enough to be acceptable. An additional "reliability-like" calculation was accomplished, where a correlation was taken between the mean responses of various distinct subgroups within the test population. The correlations were very high. The instrument was declared reliable.

Potential for future research

In-depth priority scheme. The scheme for stating priority of obstacles to be addressed by training programs is currently at the level of the first-level nomological, which can be described as the level of the "grand scale." A logical follow-through would be to produce a priority schedule that is at the second-level nomological, so that action might be taken to rectify the symptoms, themselves, as a means of "curing the disease" of the obstacle (or first-level nomological) to problem solving or communication.

Prescriptive system. A more interesting (to the author) opportunity is to use the instrument in a large number of organizations from a variety of industries, first establishing a profile of the organizations and the way they operate, and then applying the questionnaire. The goal would be to identify what was being done in the various organizations that was different, that could be related to the low priority items, and, ultimately, to build a prescriptive system for overcoming the ills of various organizations, based on what one organization was doing well that another was not. In other words the end product of the research would be a highly objective cause and effect system to analyze organizational ills and to prescribe cures for those ills, based on the successful experiences of other organizations.

Use of the instrument

The questionnaire is intended to provide management information that will be useful in strengthening a large organization's ability to succeed in problem solving and in communication. The principal method originally anticipated for the strengthening process was training of the staff in topics specific to the obstructive factors (first-level nomologicals) that scored high in the priority calculation. The test case suggested that the information provided by the priority statistic is also, for observant managers, useful for planning organizational activities other than training that may help strengthen problem solving and communication in the organization. In the instance of the test case modifications to management practice and the initiation of action programs were considered by the organization's management more significant to the organization than were the training activities that resulted from the study. In other words the information provided through application of the questionnaire and analysis of its results has uses that are broader than those initially anticipated.

DISCUSSION OF VALIDITY AND RELIABILITY AND THEIR APPLICATION TO THE INSTRUMENT

This section deals with validity and reliability as applied to the instrument. The section is organized so that a brief review of relevant literature, exploring a basic concept, precedes the discussion of the way in which the concept is applied to the study. The purpose for organizing the section this way is to assure that at the time the application of the concept to the study is discussed the reader has essentially the same perspective of the concept as the author.

Validity

Four types of validity have become generally accepted as a result of their being (in effect) approved by the American Psychological Association (Technical Recommendations, 1954), by the American Educational Research Association, and by the National Council on Measurements Used in Education (Committee on Test Standardization, 1955). These four types are "concurrent" validity, "predictive" validity, "content" validity, and "construct" validity.

Criterion oriented validation. The first two categories, concurrent validity and predictive validity, may be considered together as "criterion-oriented" validation procedures (Cronbach and Meehl, 1955). Criterion validity refers to the correlation between one measure and a direct measure of the concept being considered. The direct measure is assumed to correspond exactly, or nearly so, with the concept. The pattern of criterion-oriented validation begins with an investigator who is primarily interested in some criterion he wishes to predict. He applies his instrument, obtains an independent criterion measure on the same subjects, and then computes a correlation. If the instrument is applied at the same time as the independent criterion, the investigator is concerned with concurrent validity.

Examples of problems in predictive validity would include the instances in which an investigator seeks to develop an instrument that will accurately predict in January the outcomes of a general election to be held the following November, or in which a researcher attempts to develop an instrument that may be administrered to high school students to predict success in college. An example of a problem in concurrent validity would be to administer a test on basic concepts in sociology to a sociology class and at the same time receive a report from the class instructor as to the abilities of the students with respect to the area being tested.

Content validity. Content validity is essentially judgment. It is presenting a reasonable argument by showing that the elements (items) on the instrument are a representative subset (sample) of the universe being investigated. Other names for content validity are "face" validity and "logical" validity. It is usual for content validity to be described in terms of the relevance of an instrument to different types of criteria, such as analyses of jobs or courses of study, statements of organizational objectives, concepts of social utility, collective judgments (panels) of competent persons, and logical (or psychological) analyses of behavior. A simple example would be the use of arithmetic problems on an arithmetic test.

Contruct validity. Construct validity, originally referred to as "concurrent" validity (Technical Recommendations, 1952), is the most recently defined validation

category, having been formally described as "construct" validity in the Technical Recommendations of 1954. It (construct validity) is involved whenever an instrument is intended to measure attributes or qualities that are not clearly (operationally) defined, when the relationship between the instrument and the attributes or qualities to be studied is inferential (indirect) rather than specific. In general construct validity is used when neither content validity nor criterion-oriented models will suffice.

> "Construct validity is ordinarily studied when the investigator has no definite criterion measure of the quality with which he is concerned, and must use indirect measures. Here the trait or quality underlying the instrument is of central importance... (Technical Recommendations, 1954)."

Content validity, concurrent validity, and predictive validity are often considered to be specialized aspects of construct validity when appropriate criteria are available. Construct validity is usually applicable to instruments that investigate things like study habits, appreciations, understandings, and interpretation of data.

Because of construct validity applying to areas that are qualitative in nature, a structured approach to construct definition is important. To that end, Cronbach (Cronbach and Meehl, 1955) suggests the development of a "nomological network" for each construct to be evaluated. The characteristics of a nomological network are:

1. The nomological network, itself, shall consist of a theory constituted of an interlocking system of laws.

2. The laws relate:

   a. Observable properties or quantities to each other.
   b. Theoretical constructs to observables.
   c. Different theoretical constructs to each other.

3. For a construct to be scientifically admissible, it must include at least some laws involving observables in its nomological network.

4. More is learned about a construct by elaborating the nomological network.

5. Justifiable network enrichment occurs if it generates nomologicals (laws or law-like statements) that are confirmed by observation or if it reduces the number of nomologicals required to predict the same observations.

6. Measurements which are qualitatively very different may be said to overlap or to measure the same thing if their positions in the nomological network link them to the same construct variable (concepts correlate with each other on an instrument in the way predicted by theory).

In keeping with the perspective of a scientific approach, construct validation can be considered rigorous in that the nomological network makes contact with observations and exhibits explicit, public steps of inference. When these conditions are met the investigator may justifiably claim construct validation (Cronbach and Meehl, 1955).

Importance of validation. A test or measurement instrument that has not been subjected to rigorous validity studies is suspect. With standardized tests it is reasonable to expect the test manual to contain information about the method of choosing test items, the characteristics and composition of the sample (or population) upon which the test was standardized, and the criteria used in validating the test. Without such information the test may be considered of questionable value. Equally questionable is the value of research conducted using custom instruments that have not been subjected to similarly rigorous scrutiny.

Validity as applied to the instrument

The principal method of validation applied to the questionnaire is construct validity. There are, additionally, overtones of content validity in that the constructs and their related nomological network are derived from the literature of management and sociology.

The orientation of the questionnaire is toward obstacles to the successful conduct of problem solving and communication activities. In other words the constructs that were developed were "obstacles to problem solving" and "obstacles to communication." To that end two levels of nomologicals (laws or law-like statements within the nomological network) were developed for each construct. The first level consists of statements of specific obstacles to problem solving or communication. The second level of nomologicals consists of conditions that are symptomatic of the specific obstacles.

Reliability

The other consideration in the development of research instruments is reliability, which is usually defined as the consistency with which an instrument yields the same results in measuring whatever it does measure. Reliability may exist for an instrument without validity, since it is reasonable for a test, for example, to consistently measure something quite foreign to what was intended for it.

Reliability is in fact a class of characteristics that apply to data collection instruments. The class includes stability, equivalence, and internal consistency.

The methods of estimating reliability involve some way of obtaining at least two measures with the same instrument or equivalent instruments and determining the agreement between them. The closer the agreement between different applications of the same instrument, the greater its reliability.

Test-retest method. The test-retest method of estimating reliability involves administration of the same instrument to the same target population (or sample) on at least two different occasions. The results of the two administrations are correlated to estimate reliability. The correlation coefficient that results is often referred to as the "coefficient of stability (Remmers, 1960)." Test-retest reliability measurement makes the assumption that there is no change in true scores between the two test administrations.

Equivalent-forms method. The equivalent-forms method requires the development of different versions of an instrument that are essentially alike in the kind of content, necessary mental processes, number of items, difficulty, and so on. The

subjects are administered one form of the instrument and, as soon as possible, the other form. A correlation coefficient, in this case called a "coefficient of equivalence (Remmers, 1960)" is then calculated to assess agreement between the forms. If agreement is high, each form can be said to provide accurate measurement.

Split-halves method. The split-halves method divides the items of a single instrument into halves, usually by randomly assigning items to each half or by pooling the even-numbered elements for one score and the odd-numbered elements for another, resulting in two instruments that are very much alike, including all of the human related circumstances of administering the instrument, such as mental set, distractions, fatigue, and so on. The results of calculating a correlation coefficient between two halves are a reflection of the reliability of half of the instrument. The Spearman-Brown prophecy formula allows estimation of the reliability of the whole test:

$$\text{Reliability of the lengthened test} = \frac{nr}{1 + (n - 1)r}$$

Where n = the number of times the instrument is lengthened, and

r = the original reliability coefficient (Remmers, 1960).

Two other formulas that do not require calculating a correlation coefficient or correcting using the Spearman-Brown prophecy formula are frequently used for estimating reliability. The first:

$$r = 2\left(1 - \frac{s_o^2 + s_e^2}{s_t^2}\right)$$

where s_o = the standard deviation of the first half,

s_e = the standard deviation of the second half, and

s_t = the standard deviation of the instrument as a whole,

and the second:

$$r = 1 - \frac{s_d^2}{s_t^2}$$

where s_d = the standard deviation of the differences between half-instrument scores and the standard deviation of the total instrument, and

s_t = the standard deviation of the instrument as a whole (Remmers, 1960).

Kuder and Richardson have developed a formula for estimating internal consistency that has been shown to yield a coefficient equal to the mean of all the possible split-half coefficients of an instrument, when all items are scored 1 and 0. The formula, Kuder-Richardson's "20" is:

$$r = \frac{n}{n-1} \cdot \frac{s_t^2 - \sum pq}{s_t^2}$$

where n = the number of items in the instrument,

s_t = the standard deviation of the total instrument scores,

p = the proportion of persons "passing" each item, and

q = 1 - p (Kuder and Richardson, 1937).

Cronbach has elaborated upon Kuder-Richardson's "20" with his coefficient Alpha, which is a more general (allowing other than 0 and 1 as responses to items) formula:

$$\text{Alpha} = \frac{n}{n-1} \cdot 1 - \frac{\sum s_i^2}{s_t^2}$$

where s_i = the standard deviation of item scores after weighting,

s_t = the standard deviation of total instrument scores,

which in turn reduces to Kuder-Richardson's "20" when all items are scored 1 and 0 (Cronbach, 1951). Kuder-Richardson's "20" and Alpha are considered as estimates of internal consistency.

Factors affecting reliability. Three factors affect the reliability coefficient:

1. The length of the instrument.
2. The range of talent among the participants.
3. The conditions under which the instrument is administered.

In the instance of the length of the instrument, all other things being equal, the longer the test the greater the reliability coefficient, up to a point of diminishing returns. In the instance of range of talent or ability, the greater the variability in the group of subjects, the higher the reliability coefficient. In the instance of the conditions of administration, the greater the distractions, accidents, and cheating during the administration of the instrument and the greater the scoring inaccuracy, the lower the reliability coefficient.

Adequate reliability. The question arises as to what constitutes an adequate coefficient of reliability, particularly in light of the obvious fact that no instrument is perfectly reliable? The answer is that, depending on the circumstances, very low values may be appropriate, but the higher the coefficient the better. The following formula for the standard error of a score:

$$S.E. = s_t \sqrt{1 - r_{tt}}$$

where s_t = the standard deviation of the scores on the instrument, and
r_{tt} = the reliability coefficient of the instrument (Remmers, 1960),

is a useful guide in determining what is an acceptable minimum reliability coefficient. The results of this calculation is the probable range below and above the score on the specidied administration of the instrument within which an individual might be expected to fall on repeated adminsitrations of the instrument. Thus, if the investigator is able to tolerate a relatively large range of variance in scores by an individual on repeated administrations of the instrument, a relatively low reliability coefficient may be acceptable.

Reliability as applied to the instrument

In the development of an instrument to accurately represent the nine obstacles to problem solving and communication an internal consistency measure is the most appropriate means of determining reliability. As a result, the decision was made to select Cronbach's Alpha to demonstrate reliability. The method of calculating Alpha was not the exact method described earlier in this section. Rather than using the equation (Cronbach, 1951):

$$\text{Alpha} = \frac{n}{n-1} \cdot 1 - \frac{\sum s_i^2}{s_t^2}$$

where s_i = the standard deviation of item scores after weighting, and
s_t = the standard deviation of total instrument scores,

the equivalent equation (Schuessler, 1971):

$$\text{Alpha} = \frac{\text{Mean Square (Blocks)} - \text{Residual}}{\text{Mean Square (Blocks)}},$$

where the mean square (blocks) and the residual are derived from an analysis of variance,

was selected for use.

As an additional measure of intergroup consistency the mean responses to first-level nomologicals was correlated between three distinct samples within the test population. In addition the three samples' mean responses were correlated with the mean responses to the same level nomologicals by the total test population. Although this measure does not fit neatly into one of the recognized types of reliability, it is, never-the-less, "reliability-like," giving an indication of the similarity of response between selected groups within the test organization and indicating consistency of application of the instrument to groups with different characteristics as well as the extent to which the items on the instrument are homogeneous.

THE INSTRUMENT

Organization of the instrument

Three types of questions were included in the instrument (Wasik, 1972). The first type of question, when viewed in light of the complete set of questions, constitutes a symptomatic diagnostic system for determing the presence of the first-level nomologicals, which are in turn specific obstacles to problem solving and communication. The symptoms, which are the second-level nomologicals, are restated as one or more questions, each, that are answerable by either yes or no. The sequence of appearance of questions on the instrument was arrived at randomly. There were originally 55 questions of this type on the instrument when it was administered to the test population. Two questions were subsequently eliminated because of wording problems.

The second type of question was a restatement of the first-level nomologicals so that they could be responded to on a ten point rating scale (0 through 9), with the respondents indicating their opinion as to the extent to which the nomologicals were present in the organization. The third type of question was also a restatement of the first-level nomologicals so that they too could be responded to on a ten point rating scale. In this instance, however, the respondent indicated his opinion as to the extent to which the presence of the nomological interfered with the performance of his duties. The second and third types of questions were randomly mixed together and were treated as a second section of the instrument.

In addition to the three types of construct related questions, four demographic items were included. They were sex, number of years of education, age, and race. The purpose for inclusion of these items was to provide for correlations of responses between various types of participants. This was done at the specific request of the executive level management of the test case organization.

Validity

The nomological network. The following is an example of the development of the nomologicals and their related questions for the first type of question:

1. For the first-level nomological, "Lack of clarity in stating the problem," the second-level nomologicals and corresponding questions are:
   a. Inadequate time is available to analyze problems so that they are not thoroughly understood (Lippitt, 1969).
      1) Do you have adequate time to analyze problems to the point where you thoroughly understand them?
      2) When working in a group problem solving situation, does the group take the time to be sure everyone understands each problem before attempting to select a solution?
      3) When you first encounter a problem, is its exact nature usually clear to you, Immediately?
   b. A good decision depends on the maker being consciously aware of all the factors that set the stage for the decision (Massie, 1964).
      1) Are solutions to a problem usually tried, even though the problem is not well understood?
   c. A problem must be well-defined to be well-solved (Dewey, 1910).
      1) Do you feel that an inadequately stated problem will be poorly solved?

The following are examples of the development of the nomologicals and their related questions for the second type of question:

The following obstacles and the related questions are associated with the construct, "Obstacles to problem solving:"

1. For the first-level nomological, "lack of clarity in stating the problem," the rating scale item is:

   a. Does the tendency to seek solutions to inadequately stated problems interfere with your ability to do your job?

   /0 /1 /2 /3 /4 /5 /6 /7 /8 /9 /

2. For the first-level nomological, "premature testing of alternatives," the rating scale item is:

   a. In the group decision-making process does premature evaluation of alternative problem solutions produce results that interfere with your doing your job?

   /0 /1 /2 /3 /4 /5 /6 /7 /8 /9 /

The nomologicals and their corresponding questions for the third type of question were developed exactly as were those for the second type of question.

Linking the nomological network with observables. In addition to development of the nomological network, which is derived from the literature and which in effect predicts the relationships between the concepts being studied and the items on the instrument, it is essential that the nomological network makes contact with empirical observations (Cronbach and Meehl, 1955). To that end a factor analysis was run using the Statistical Analysis System (Service, 1972). An orthogonal rotation was used in the factor analysis to allow maximum independence between factors as they relate to items. Input data to the factor analysis were the 73 responses to the instrument's items for the 118 respondents in the test case.

Twenty-five factors resulted from the factor analysis. Examination of the Rotated Factor Matrix was directed toward linking questionnaire items with first-level nomologicals. The minimum factor loading, the weight of a factor relative to all other factors (Schuessler, 1971), that was considered significant was 0.35.

Figure 1 is a sample of a summary of the significant factor loadings as they appear in the rotated factor matrix. The item number and the related first-level nomological number are also included. All items were significant for at least one factor. In reading Figure 1 look under each factor for item information in the following format:

On the first line...
Part of the instrument (i.e., B), item number (i.e., 24),
...dash...number of the related first-level nomological.
On the second line...
Factor loading.

Figure 2 is a sample of an additional level of summation in that items and factor loadings from the Rotated Factor Matrix are linked with their related first-level and second-level nomologicals. A logical relationship may be described for the items

FACTOR	1	2	3	4	5
	B24 - 5	B18 - 7	B23 - 4	B 8 - 8	B28 - 4
	-0.36547	-0.41405	0.70637	0.40173	0.55539
	B28 - 4	B31 - 8	B25 - 8	B17 - 5	B32 - 7
	-0.37180	0.78654	-0.37278	-0.82130	0.40663
	B33 - 8	B38 - 2	B27 - 8	B42 - 5	B35 - 4
	-0.39484	0.62002	-0.36717	-0.41854	-0.50354
	B41 - 4		B48 - 6	B47 - 3	B49 - 5
	-0.36365		0.39593	-0.71176	-0.70341
	C 1 - 7			B48 - 6	
	-0.65291			-0.46398	
	C 2 - 8				
	-0.77649				
	C 6 - 6				
	-0.58116				
	C 7 - 7				
	-0.53657				
	C 8 - 8				
	-0.69601				
	C 9 - 8				
	-0.73089				
	C10 - 9				
	-0.70519				
	C14 - 2				
	-0.44544				
	C15 - 3				
	-0.64082				

SAMPLE OF ROTATED FACTOR MATRIX, SUMMARIZED

Figure 1

appearing in each selected factor. The numbers for first-level nomologicals and the identifiers (alphabetic character) for second-level nomologicals that appear in Figure 2 are those used in "The nomological network for obstacles to problem solving" and "The nomological network for obstacles to communication" from which samples appear earlier in this paper. The item number is a combination of the Part of the instrument and the item numbers as they appear on the instrument.

FIRST-LEVEL NOMOLOGICAL NUMBER	SECOND-LEVEL NOMOLOGICAL IDENTIFIER	ITEM NUMBER	FACTOR NUMBER	FACTOR LOADING
1	a	B10	10	-0.62103
1	c	B51	10	0.40248
1	a	B 6	12	0.76547
1	-	C13	24	0.43776
2	c	B52	17	0.82616
2	a	B 1	18	-0.79760
2	a	B 5	21	-0.74821

SAMPLE OF

RELATIONSHIPS BETWEEN SIGNIFICANT FACTOR LOADINGS

AND NOMOLOGICALS

Figure 2

Figure 3 is a sample of all of those factors that appear in Figure 2, with all of the items within those factors whose factor loading exceed 0.35 being described. The entire item is stated so that the logical relationships between the items may be observed.

Briefly reviewing, Figure 1 identifies all of the items with respect to their factors, where the factor loadings for the items with respect to the factors exceed 0.35. Each of the items on the instrument loaded above 0.35 on at least one factor; thus, there is a relationship that may be considered significant between each item and at least one factor.

Figure 2 is derived from the information in Figure 1. Its contents represent the cases where an item clearly relates to first-level and second-level nomologicals in the factor analysis. It also establishes interrelationships between factors, as they appear in the Rotated Factor Matrix, where two or more factors may be presumed to represent different aspects of the same dimension.

FACTOR 1

ITEM DESCRIPTION		FACTOR LOADING
B24.	Do you feel that the working climate is so repressive that it prevents your making your best contribution to the problem solving process?	-0.37547
B28.	Are there members of the problem solving groups with which you work who consistently block the group from success in the decision-making process?	-0.37180
B33.	Do you often withhold essential information from the people for whom you work?	-0.39484
B41.	Do you feel that there are many members of the problem solving teams to which you belong who could be described as "recognition seekers?"	-0.36365
C 1.	Do you feel that people with management responsibility should operate only within the formal communications structure?	-0.65291
C 2.	How often do you find that you are uncertain about what information is needed at higher levels in the organization?	-0.77649
C 6.	Does pressure to conform to the behavioral standards and views of the problem solving groups with which you work interfere with your doing your job?	-0.58116
C 7.	Does lack of understanding of the formal communications structure interfere with your doing your job?	-0.53657
C 9.	Does withholding of essential information by higher management from lower management effect your ability to do your job?	-0.69601
C10.	Do vested interest groups interfere with the operation of the organization?	-0.73089
C14.	In the group decision-making process does premature evaluation of alternative problem solutions produce results that interfere with your doing your job?	-0.70519
C15.	Does lack of decision-making skills on the part of team leaders and/or team members interfere with your doing your job?	-0/44544

SAMPLE OF ITEM DESCRIPTIONS WITHIN FACTORS

Figure 3

Figure 3 expands on the factors in the Rotated Factor Matrix that were used in Figure 2. Where Figure 2 displays selected items with a factor loading greater than 0.35 to establish relationships between observables and the nomologicals as predicted by the nomological network, Figure 3 displays all items with a factor loading of 0.35 or greater for each factor that was used in Figure 2. Figure 3, then, provides a means for viewing the subjective logic of the interrelationships between significant items in the selected factors as found in the Rotated Factor Matrix and provides a representation of factors as they occurred in the reality of the test case.

As expected, the constructs (nomologicals) are not unidimensional. The factors as derived from the literature seem to be tapping different dimensions as evidenced by the variation of the factor analysis from the theoretical network of nomologicals. This suggestion of the measurement of several not unexpected dimensions of the constructs is the probable result of the trade-offs between theoretical purity and the utility of the instrument needed for measuring the real social situation of the test case.

The factor analysis points to a relatively high interrelationship between the first-level nomologicals. Not all the nomologicals were fully supported in the factors shown in Figure 2 and in Figure 3, but all the factors are supported by the Rotated Factor Matrix as exemplified by Figure 1. The factor analysis can be said to support the nomological network, so that observables are related to first-level and second-level nomologicals.

Statement of validity. The nomological network has been developed so that one can relate to the logic of its development. Through the use of factor analysis it has been shown that there are clear linkages between the network and observables (obtained in the test case). Based on the logical development fo the network and the established contact between the network and observables, construct validity may be claimed for the instrument.

Reliability

An analysis of variance was produced using the Statistical Analysis System (Service, 1972) at the Triangle Universities Computation Center through the Computer Center at North Carolina State University. The following results were generated:

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE
Blocks	117	816.6842	6.980207
Item	72	11332.2644	157.392561
Residual	8178	8773.0700	1.072765
Corrected Total	8367	20922.0186	2.500540

ANALYSIS OF VARIANCE TABLE FOR TEST CASE DATA

Figure 4

The mean square (blocks) and the residual from the preceding figure were used in the following equation:

$$\text{Alpha} = \frac{\text{Mean Square (Blocks)} - \text{Residual}}{\text{Mean Square (Blocks)}},$$

$$\text{Alpha} = \frac{6.980207 - 1.072765}{6.980207}$$

$$\text{Alpha} = 0.8463132$$

This value for Alpha is accepted as adequate evidence of internal consistency (reliability) based on the acceptability of the standard error of a score on the instrument as derived below:

$$\text{S.E.} = s_t \sqrt{1 - r_{tt}}$$

$$\text{S.E.} = 23.038662 \sqrt{1 - 0.8463132}$$

$$\text{S.E.} = 9.0318236$$

As additional evidence of reliability, the data in Figure 5 were used to produce a correlation between mean responses by distinct samples within the management population of the test organization. In Figure 5 observations 1 through 9 are the average or mean responses to the diagnostic type questions. Observations 10 through 18 are the average or mean responses to the ratings of presence of the obstacles. Observations 19 through 27 are the average or mean responses to the ratings of the extent to which the obstacles interfere with the participants doing their job (Crumpton, 1973). The correlation was run on this data set to produce the results shown in Figure 6.

The resulting correlations between the groups were very high. In every instance the probability of the similarity between responses being by chance alone was one in 10,000 or less (the 0.0001 level). In other words, the responses of all participant groups were very much alike. Figure 6 represents the output of the computer run. All labels are the same as those used in Figure 5.

Based on the statistics described in this section it may be concluded that the questionnaaire displays a high degree of reliability. It can also be expected to give consistent results with a varied group of participants within the target organization.

OBS	OVERALL	GROUP A	GROUP B	OTHERS
1	0.494	0.455	0.482	0.501
2	0.414	0.333	0.444	0.429
3	0.381	0.313	0.389	0.409
4	0.270	0.286	0.226	0.275
5	0.280	0.299	0.250	0.288
6	0.394	0.394	0.361	0.392
7	0.413	0.459	0.250	0.493
8	0.332	0.303	0.329	0.334
9	0.689	0.545	0.792	0.671
10	3.000	2.909	4.250	2.853
11	2.924	3.182	2.833	2.905
12	3.534	3.636	3.167	3.568
13	2.492	2.818	2.750	2.421
14	2.322	2.273	3.750	2.147
15	2.303	4.273	2.917	3.116
16	6.136	5.273	5.667	6.295
17	2.992	2.364	2.750	3.095
18	3.381	4.318	3.169	3.300
19	2.237	1.636	2.417	2.285
20	2.110	2.182	2.417	2.063
21	2.195	2.273	2.583	2.137
22	1.780	2.364	1.917	1.695
23	1.873	1.727	2.083	1.863
24	2.008	3.000	2.750	1.800
25	1.568	1.000	1.417	1.653
26	1.958	1.636	2.875	1.879
27	2.008	1.909	2.000	2.021

LISTING OF INPUT DATA FOR CORRELATION BETWEEN

OVERALL, GROUP A, GROUP B, AND OTHERS

Figure 5

N = 27

	OVERALL	GROUP A	GROUP B	OTHERS
OVERALL	1.000000 0.0000	0.920350 0.0001	0.946753 0.0001	0.991552 0.0001
GROUP A		1.000000 0.0000	0.901619 0.0001	0.932028 0.0001
GROUP B			1.000000 0.0000	0.930691 0.0001
OTHERS				1.000000 0.0000

CORRELATION BETWEEN RESPONSES OF
OVERALL, GROUP A, GROUP B, AND OTHERS
(CORRELATION COEFFICIENTS / PROB > |R| UNDER HO: RHO = 0)

Figure 6

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APPENDIX

Six of the many possible obstructive factors relating to problem solving that are identified as being of importance are (Lippitt, 1969):

1. Lack of clarity in stating the problem. An ill-stated problem is essentially unsolvable.

2. Premature testing of alternatives in making decisions. In the problem solving situation managers tend to take each problem to be solved and treat it individually rather than accepting a variety of problems and addressing them, in-so-far as possible, as a unified whole; thus, losing the benefits of exploring the interrelationships among problems.

3. Lack of decision-making skills. Decision-making is a highly demanding and extremely complicated cognitive and emotional process. It needs to be continuously seen in both of those dimensions. Strong, well-trained, leadership seems to produce the most efficient decision-making. Group members should also become strong diagnosticians and interveners.

4. Self-oriented behavior. The individual's conflict with the decision-making group because of a strong self-orientation causes the individual to appear obstructive and reduces group problem solving effectiveness.

5. Unsatisfactory working climate. The individual functions most effectively within the group problem solving situation when he has a high degree of security. The following equation is intented to be a simple representation of the security situation:

$$\text{Security} = \frac{\text{Perception of own power + Friendly forces}}{\text{Unfriendly forces}}$$

6. Conformity and homogeneity. Group pressures encourage conformity among managers to the detriment of creative decision-making. Groups seeking better decisions may expand their norms to increase tolerance of unconventional contributions. Better choices should emerge from an enlarged repertoire of alternatives.

Many obstructive factors that interfere with communication within organizations have been identified. The following three (Simon, 1957) were selected as relative to the study:

7. Lack of understanding of the formal organization. The formal organization is articulated to facilitate the operation of the organization. Uncertainty or ignorance of its operation interferes with efficient communication of needed information to correct positions in a timely and appropriate manner, often resulting in the development of cliques.

8. Not providing the types of information needed at other organizational levels. A major problem of higher levels of the management hierarchy is that much relevant information originates at lower levels and may not reach higher levels unless the executive is extraordinarily alert. A system of formal records and reports, for example, places the responsibility for defining information to be transmitted in the hands of the superordinate rather than the subordinate. The converse situation occurs when the superordinate withholds needed information from the subordinate either through ignorance or because of a wish to maintain or strengthen his authority relationship with the subordinate.

9. The presence of management cliques. Informal organizations tend to form as organizations grow and become more complex, as the means of communication established by the formal organization become less effective.